Endoscopic v/s conventional approach to sino-nasal tumours – What's the debate?

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Abstract

In the past two decades nasal endoscopy has advanced technologically to offer us magnified vision and better illumination along with better instrumentation. Surgery has traditionally been via the transfacial approaches such as lateral rhinotomy or the Weber Ferguson incision. For disease extension into the skull base traditional approach is a transfrontal craniotomy via either the bicoronal incision or the subcranial Raveh's approach. A combined access via the cranium from above and the transfacial access from below aids in encompassing the tumour all around. Transnasal access is a natural trajectory which leads us directly onto the tumour. The endoscope alone or with the microscope has been utilised to improve the magnification and illumination to aid in tumour removal. Minimal access to the Sinonasal and anterior skull base tumours is proven to be possible and feasible. We now have an additional armamentarium to our existing approaches in management of these tumours. We have to be judicious and see which approach can remove the disease completely maintaining the quality of life of the patient.

Keywords. Paranasal sinus neoplasms · Endoscopy

Introduction

Sino-nasal tumours form a small proportion of the tumour burden affecting the human body. The symptoms such as epistaxis and nasal obstruction are dramatic and tend to bring patients early on to a physician. However it is the responsibility of the physician to have a high index of suspicion for malignancy especially when dealing with a unilateral nasal swelling. Today in the era of nasal endoscopy and multi-detector, multi-planar imaging we have the capability to diagnose and plan management of sinonasal tumours far better than previously.

Surgery is usually the primary treatment of choice followed by radiation therapy barring a few exceptions. Traditionally these tumours are accessed using facial approaches such as medial maxillectomy or total maxillectomy and sometimes in combination with a cranial approach to

encompass intracranial extensions. To avoid facial scarring sublabial approaches have been described ranging from Caldwell-Luc, Midfacial degloving to Le Fort. The sublabial approaches however reduce facial scarring at expense of space and illumination.

In the past two decades nasal endoscopy has advanced technologically to offer us magnified vision and better illumination along with better instrumentation. Since Professor Messerklinger described the 'Functional Endoscopic Sinus Surgery'¹ the transnasal approach has opened avenues for removal of tumours utilising both the microscope and endoscope. In the past decade better instrumentation and understanding of the skull base anatomy has broadened the scope of the transnasal route. Professor Aldo Stamm and Professor Wolfgang Draf have pushed the envelope utilising the transnasal route with microendoscopy.² The Pittsburgh group led by Professor Ricardo Carrou, Professor Carl Synderman and Professor Amin

Kassam described a modular ‘Expanded Endonasal Approach’ for utilising the nasal corridor for access to the entire ventral skull base.^{3,4} Their modular design has simplified the understanding of this complex anatomy and paved the way for increased interest in this trajectory to the skull base and intracranial tumour.

Progress

Endonasal access to the cranium has been utilised by the Egyptians⁵ to remove the brain during the embalming process. They used curved picks to open the cribriform plate and hook out the brain. This ingenious method of access is direct and minimally invasive. Anterior nares as natural ports for access to the skull base is now increasingly utilised to remove tumours of the nose and the paranasal sinuses. Alongside improved angled telescopes, powered instrumentation has vastly improved our access and resection capabilities. Microdebridders allow us easier and quicker soft tissue clearance under clearer vision. Self irrigating high speed drills give us the ability to drill bone with impunity adjacent to vital structures such as dura, optic nerve or internal carotid artery. Real time Intraoperative navigation with intraoperative CT or MRI scanners have manifold improved our safety while clearing tumours in vicinity of critical structures. 3-D high definition endoscopy is an emerging technology that promises to improve our visual and resection capability.⁶

Biology of tumours

The nose and the paranasal sinuses present us with a unique array of tumours with varying biology. Understanding their natural history is pertinent to treatment planning. Amongst benign tumours the two most commonly occurring tumours are Inverted Papilloma and Angiofibromas. Inverted papillomas (IP) are known to arise from the lateral nasal wall and involve adjacent sinuses. They are known to recur locally and have a potential for malignant transformation to squamous cancer in 5% of cases.⁷ In IP surgical clearance has to be meticulous along with drilling of its base to prevent local recurrence. The specimen also needs careful pathological evaluation to rule out squamous cell carcinoma differentiation which will merit adjuvant radiation therapy. Busquets JM and Hwang P in their meta-analysis of conventional and endoscopic resection of IP have shown lower recurrence pattern in the endoscopic series.⁸ Juvenile nasopharyngeal angiofibromas (JNA) occur in young adolescent males and are vascular tumours which arise from cell rests along the sphenopalatine foramen and spread into the nose, paranasal sinuses and the infratemporal fossa. The giant JNA’s remodel the adjacent greater wing of sphenoid and the orbital apex expanding the infe-

rior orbital fissure and spread intracranially alongside the cavernous sinus. The treatment of choice is complete excision with drilling of the sphenopalatine region. This can be done via external or endoscopic approaches. Endoscopic access should not be attempted unless the surgeon is well versed in advanced endonasal skull base resection and manipulation of tumours in the vicinity of the cavernous sinus. Large JNA’s are best dealt with via an open approach.

Amongst malignant tumours adenocarcinoma, esthesioneuroblastoma, neuroendocrine tumour, adenoid cystic carcinoma and squamous cell carcinoma are more common. Due to varied histologies in the paranasal sinuses it is very important to get immunohistochemistry done for accurate classification of the tumour. This will go a long way towards treatment planning and prognostication. Sinonasal adenocarcinomas (SNACs) show a variety of growth patterns. These lesions are classified as intestinal or nonintestinal, the latter subclassified as low grade or high grade.⁹ Well differentiated adenocarcinomas carry the best prognosis with survival rates exceeding 70%.

Esthesioneuroblastomas (ENB) are olfactory groove neuroendocrine tumours. These carry extremely good prognosis when limited to the nose (Kadish A) or upto the cribriform plate (Kadish B). Even the advanced ENB going Intracranially (Kadish C) or those with metastatic disease (Kadish D) do relatively better than the squamous cell, sinonasal undifferentiated, small cell neuroendocrine and other high grade cancers. ENB should be treated aggressively with surgery and radiation therapy and those with advanced stages even with combination including chemotherapy. Dulgerov et al.¹⁰ did a meta analysis of reports on ENB from 1990 to 2000 and they found that survival in Hyams’ grades I–II was 56% compared with 25% in grades III–IV. In patients with metastases in cervical lymph nodes (on average 5% of the total) survival was 29%, compared with 64% for patients with N0 disease. Survival according to treatment modalities was 65% for surgery plus radiotherapy, 51% for radiotherapy and chemotherapy, 48% for surgery, 47% for surgery plus radiotherapy and chemotherapy, and 37% for radiotherapy alone. The histopathological grading according to Hyams and the presence of cervical lymph-node metastases emerged as prognostic factors. A combination of surgery and radiotherapy seems to be the optimum approach to treatment. The exact role of chemotherapy in treatment protocols is still unclear.

Neuroendocrine tumours are notorious in the paranasal sinuses and are very difficult for the pathologist to differentiate between sinonasal undifferentiated carcinoma (SNUC), neuroendocrine carcinoma (NEC), and small cell carcinoma (SmCC). The MD Anderson experience¹¹ shows the local control rate at 5 years was better for SNUC (78.6%) and NEC (72.6%) while it was 66.7% in SmCC. The regional failure (RF) rate at 5 years was

15.6% for patients with SNUC, 12.9% for patients with NEC, and 44.4% for patients with SmCC. The distant metastasis rate at 5 years was 25.4% for patients with SNUC, 14.1% for patients with NEC, and 75.0% for patients with SmCC. Thus neuroendocrine tumours cannot be clubbed together but should be differentiated for better treatment planning.

Adenoid cystic carcinomas (ACC) are indolent tumours and usually present with locally advanced stages. Since the ACC have neurotropic spread it is important to evaluate with an MRI scan to rule out involvement of the adjacent nerves, i.e. the vidian and maxillary division of the trigeminal nerve. In the MD Anderson experience¹² of 105 patients over 14 years most patients presented in advanced stages [T3/T4 (76.7%), N0 (98%)]. The local recurrence rate was 30%, and the distant metastases rate was 38% and most distant metastases were in the lungs. The 5-year overall survival and disease specific survival rates were 62.9% and 70.9% which highlights the fact that local recurrences develop in a significant percentage of patients, survival from this disease exceeds that of other sinonasal malignancies. Squamous cell carcinoma (SCC) is a high grade cancer with high propensity to neural spread as well as locally invasion. These tumours usually do not lend themselves to endoscopic resection unless associated with inverted papilloma which have transformed to SCC.

Evaluation

Understanding of the paranasal sinus and anterior skull base tumours has been revolutionized with advent of modern imaging and sinus endoscopy. Modern imaging has come of age with multiplanar technology. The new CT scan machine are multislice with better resolution up to 0.65 mm while MRI scanners allow us different sequences to delineate not only the anatomy but also allow us to estimate its content. With diagnostic nasal endoscopy we can evaluate the extent of tumours with magnification and better illumination. Structures seemingly involved by tumours on imaging can be delineated better giving a comprehensive understanding of the disease extent. Partial voluming which on radiologic imaging creates a false impression of tumour involvement of a structure can be clarified with diagnostic nasal endoscopy. Thus imaging and endoscopy are an integral part of modern evaluation of a paranasal and anterior skull base tumour.

Tumours in the anterior skull base often appear extensive and forebearing. Characterisation of the involved structures, delineation of the orbit, dura and the cranial nerves is possible with information from both CT and MR. Sequencing in the MR can give us more information of the dural enhancement, characterise disease type and extent and may well make the difference while con-

templating extensive futile surgery. The CT scan gives us information of the bone involvement. The MRI differentiates tumour from secretions and can clearly delineate whether the orbit, dura or the nerves are involved. We need to combine this information to plan the treatment. Hence it is mandatory to get CT scan and MRI for evaluating a paranasal sinus/anterior skull base tumour.

Treatment planning

Most tumours in the paranasal sinuses and anterior skull base require combined modality treatment. Surgery forms an integral part of the combination along with radiation therapy. Chemotherapy may either be used in the induction setting (tumours with gross intracranial spread, those with very high grade) or in the concurrent setting with radiation therapy (high grade tumours, involved margins, higher potential to recur local or distant). Radiation therapy is very vital in the adjuvant setting. Conformal radiation therapy (3-D or IMRT) is mandatory to contour the tumour bearing areas and protect the optic nerves and brain as much as possible.

Surgery has traditionally been via the transfacial approaches such as lateral rhinotomy or the Weber Ferguson incision. Midfacial degloving approach allows us similar access to the midface. These approaches are well described and give us good access to the paranasal sinuses. For disease extension into the skull base traditional approach is a transfrontal craniotomy via either the bicoronal incision or the subcranial Ravich's approach. A combined access via the cranium from above and the transfacial access from below aids in encompassing the tumour all around.

Why transnasal surgical access?

Transnasal access is a natural trajectory which is directly onto the tumour and hence has been explored by many surgeons in the past two decades. The endoscope alone or with the microscope has been utilised to improve the magnification and illumination to aid in tumour removal. Techniques have improved and so has the ability to remove tumours radically. Utilising techniques designed to remove benign but large tumours such as inverted papillomas and juvenile nasopharyngeal angiofibromas it became more apparent that this trajectory can lend itself to removal of paranasal sinus and anterior skull base tumours. Kamel R¹³ gave an elegant description of endoscopic medial maxillectomy for removal of inverted papillomas highlighting the feasibility of resection of all structures as in a conventional medial maxillectomy. Starting from the early nineties groups in Belgium, Austria, Germany and Italy have been steadily removing select tumours with improving results. Stammberger H et al.¹⁴

from Graz, Austria published encouraging report of 36 malignant paranasal sinus tumours resected endoscopic with the esthesioneuroblastomas having 100% survival with 37 months followup. Goffart Y et al.¹⁵ from Belgium published a retrospective study of 78 cases from two centres in Belgium. They reported 2-years and 5-years survival rates of 73.1% and 52.3% respectively amongst the entire group, while the adenocarcinoma group exhibited a significantly better prognosis than other histological types with 2-years and 5-years survival rates of 89.8% and 63.8%. Recently Nicolai P, Capabianca P et al.¹⁶ from two centres in Italy reported on a 10 year data with 184 malignant tumours. The most frequent histotypes encountered were adenocarcinoma (37%), squamous cell carcinoma (13.6%), olfactory neuroblastoma (12%), mucosal melanoma (9.2%), and adenoid cystic carcinoma (7.1%) and they reported a 5-year disease-specific survival was 91.4% for those resected exclusively endoscopically and 58.8% for those resected with craniotomoscopic techniques.

In the past decade the transnasal access has grown further with forays made into the cranium. Professors Kassam, Carrou and Snyderman from Pittsburgh, USA have revolutionised it with their 'Expanded Endonasal Approach'.^{3,4} This modular form of resection of the skull base has been made more appealing with indepth description of the steps of resection in the coronal and sagittal plane. The minimally invasive surgery is minimal only its form of access. But the ability to resect the skull base is more or less similar to the open techniques. Instrumentation in form of powered drills, microdebridgers, angled scopes have given a tremendous fillip to this access. Neuronavigation has given more confidence in accessing these tumours which cross the skull base in vicinity of important structures such as the internal carotid artery, the optic nerves, ophthalmic, anterior and posterior communicating arteries, hypophyseal vessels and the pituitary. Precise, magnified resection is possible today of all structures which are required for a complete clearance of these tumours.

Is endonasal access suitable?

Today we have a better understanding of endoscopic skull base anatomy, improved technology and a better insight of the disease biology. Disease control via complete tumour resection remained the sole objective. However there has been a paradigm shift in the way we achieve it. The 'en bloc' resection method is gold standard and there is no disputing its efficacy. But truly the actual ability to achieve 'en bloc' resection in these tumours is doubtful. These tumours seldom come out intact and the posterior regions of these tumours are always removed piece meal. Hence this led to a rethink on the exact end point of the surgery which is a completely

resected base of the tumour with margins. Whether you achieve this via an 'en bloc' surgery or via a piece meal resection is immaterial so long as the tumour has an oncologically safe clearance. This same logic has been proven in transoral laser microsurgery to be oncologically safe. Thus if there is a planned surgical method detailing exact structures to be removed in order to achieve a complete, oncologically safe tumour resection then endonasal endoscopic resection if feasible should be considered as safe as conventional surgery.

Sinonasal tumours lend themselves for endoscopic resection. These tumours arise in the ethmoids and grow locally within the nasal cavity and extend laterally, superiorly and posteriorly. These tumours tend to hang in to the nasal cavity rather than infiltrate the surrounding structures. A diagnostic nasal endoscopy (DNE) usually reveals these tumours not involving the very structures they are reported to be involved on imaging. DNE should be part of a routine evaluation, providing us three dimensional understanding of the tumour spread which in addition to the imaging will help us plan the surgical options.

In traditional surgery the resection is standard irrespective of involvement of the structures. Medial maxillectomy involves removal of the frontal process of the maxilla, lacrimal bone, lamina papyracea part of maxilla medial to the infra-orbital foramen, the middle turbinate and the inferior turbinate along with the lacrimal sac and the nasolacrimal duct. Thus even though the nasolacrimal duct system is uninvolved, in a conventional medial maxillectomy we end up with marsupialisation of the lacrimal sac and a potential for epiphora.

In oncologic surgery margins are essential for ensuring a safe resection. However when we consider margins during extirpation of sinonasal and anterior skull base tumours we are limited by the orbit laterally, the brain superiorly, the optic nerves and internal carotid artery posterolaterally and the pituitary gland posteriorly. Surgical margins in these would involve removing adjacent structures preserving the uninvolved vital structures with narrow margins. These margins are still possible. But when we deal with tumours extending to the sphenoid the margins are even narrower. When the tumour extends intra cranially the superior margin would be the dura which can be resected in a limited way till we reach the optic chiasma posteriorly. It is not possible to remove more basal dura. Brain involvement can never be cleared with margins. In short the sinonasal and anterior skull base tumours the margins are close and usually 'gross total resection' is possible at best.

Today endoscopic medial maxillectomy, ethmoidectomy, frontoethmoidectomy, sphenoidectomy and anterior craniofacial resection all are feasible. What the endoscopic approach offers is ability to remove the tumour under magnification and better illumination. It allows us to tailor make the resection to the tumour with

the objective of removing the tumour base completely with margins as much as possible in that region. Since we can tailor make the resection to the tumour extent, uninvolvement of structures such as nasolacrimal duct, lacrimal sac can be spared.

Combined approach

The sinonasal and anterior skull base tumours require a three dimensional resection. When these tumours involve the orbit, it needs to be resected. When these tumours involve the dura, it needs to be resected. When we employ the endoscope for resecting these tumours, it is the tool (the endoscope) that is the only difference. The bottom line is that the sinonasal tumour should be feasible for complete excision via traditional methods and in addition there should not be involvement of the anterior maxillary wall, outer table of the frontal bone and skin.

Combined endoscopic with orbital resection

When the Sinonasal tumour involves the orbit, the sinonasal part of the tumour can be resected endonasally while the orbit can be resected conventionally.

Combined endoscopic and craniotomy access

If the Sinonasal tumour involves the dura and brain, the Sinonasal part of the tumour can be resected endonasally while the dura and brain can be access via a bicoronal incision and excised.

Complete endonasal craniectomy or expanded endonasal approach

For Sinonasal tumours which have breached the anterior skull base and are involving the dura the endoscopic endonasal trajectory today is technologically advanced to access and encompass the tumour with margins. Via the transnasal access a complete resection of the Sinonasal component of the tumour is carried out. The base of the tumour which is the skull base is targeted next. To encompass the tumour all round exposure of normal dura is achieved. Bilateral complete ethmoidectomy with removal of the lamina papyracea exposes the supraorbital crest area. The Draf type III frontal sinus procedure combines both the frontal sinuses and gives access to the posterior wall of the frontal sinus which can be resected to expose normal dura anterior to the tumour at the skull base. Wide sphenoidotomy is accomplished with removal of the rostrum of the sphenoid and floor followed by drilling of the intersphenoid septae. This gives good access to the optic chiasma and jugum sphenoidale ante-

rior to it. Drilling the planum sphenoidale exposes the dura posterior to the cribriform region. Once dura all around is exposed, the ethmoid vessels are coagulated with bipolar cautery. Keeping adequate margins the dura is incised exposing the brain. After coagulating the tail of the sagittal sinus anteriorly the crista galli is exposed and separated from the dural envelope. Further dissection is with bipolar cautery separating the involved structures from the brain. Once the olfactory bulbs are reached they are cauterised with bipolar cautery and divided separating the tumour completely. Dural margins are assessed with frozen section and the dural defect repaired with fascia lata tissue and tissue glue. A nasal septal flap (Haddad–Carrou flap) if preserved can be used to provide a mucosal cover for the defect. The EEA is contraindicated when frontal bone, anterior maxillary bone, bilateral optic nerve, internal carotid artery are involved by tumour grossly.

What's the debate?

Endoscopic surgery versus conventional surgery: In our opinion there is no debate about which approach is superior. In tumour surgery the first chance is the best chance. Endoscopic approach is an addition to the existing armamentarium of the surgeon for dealing with sinonasal and anterior skull base tumours. Each patient should be evaluated completely and a decision made regarding type of surgery required based on tumour histology and structures involved. As in conventional surgical techniques gross skin involvement, bilateral optic nerve involvement, internal carotid artery involvement and gross brain involvement remain a contra indication even via endoscopic techniques. Apart from these, tumour involvement of the anterior wall of the frontal bone, the anterior wall and floor of the maxilla, overlying skin and extension of the tumour lateral to a meridian drawn through the pupil of the eye are contra indications for endoscopic resection.

Overall the decision for type of approach depends on the training of the surgeon and available resources. A surgeon should be trained in all aspects of conventional skull base surgery before venturing into endoscopic surgery. Endoscopic tumour resection is not an approach for the novice surgeon. The surgeon needs to train in endoscopic surgery and after applying it in benign conditions should venture to tumour surgery. More importantly the surgeon should have the maturity to stop and convert to a conventional approach in adverse situations. Skull Base surgery is a team effort and this team should be geared to handle all sorts of complications.

Results

From September 2002 to December 2009 we have performed 104 endonasal resections of benign and malignant

lesions. Endonasal endoscopic resection was performed in 86 patients of which 2 needed to be converted to open procedures, one for control of haemorrhage whilst the other was for oncologic safety. Endoscopic assisted craniofacial resection was performed in 6 patients while complete transnasal cranioendoscopic resection was performed in one patient. 12 patients underwent endoscopic debulking procedure. Amongst the 86 malignant lesions most common were adenocarcinomas 25% followed by esthesioneuroblastomas 11% and adenoid Cystic Carcinoma 8% amongst other varied histologies. Early results in analysis of 21 malignant cases have been encouraging

with locoregional control (31 months follow up) of 82%. Long term results will be published in the coming years.

Conclusions

Minimal access to the Sinonasal and anterior skull base tumours is proven to be possible and feasible. We now have an additional armamentarium to our existing approaches in management of these tumours. We have to be judicious and apply the best approach for optimal resection and oncologic safety. With similar if not better oncologic results the one with better quality of life should be offered to the patient.

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